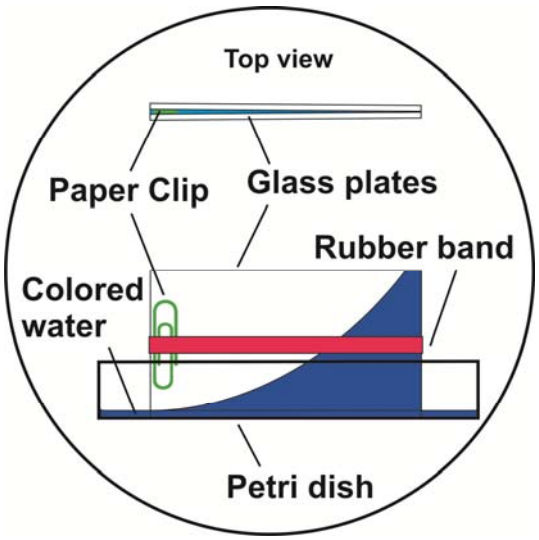
# Capillary Action
# Between Two Glass Plates




## Equipment:

2 small glass plates such as microscope slides or glass covers from small picture frames
paper clip (toothpick or similar object as spacer)
rubber band
glass beaker
glass rod
Petri dish
laboratory wipes

## Chemicals:

water
food coloring
possibly acetone

## Safety:

acetone ($CH_3COCH_3$):

H225, H319, H336, EUH066
P210, P233, P305 + P351 + P338

Both liquid acetone and acetone vapor are highly flammable. Acetone has a relatively high vapor pressure and should be handled only with adequate ventilation or in a fume hood. It causes serious eye irritation and repeated exposure may cause skin dryness or cracking. Therefore, it is strongly recommended to wear safety glasses and protective gloves.

## Procedure:

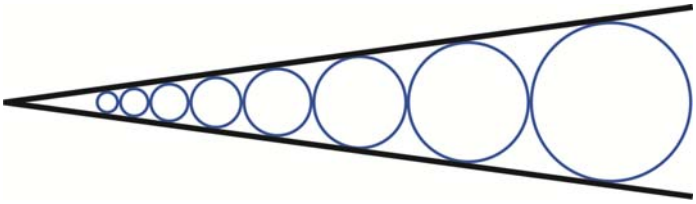
Preparation: The water in the glass beaker is dyed with dark food coloring such as blue. Subsequently, the Petri dish is filled with a shallow layer of the dyed water. If necessary, the glass plates are degreased by wiping them with a laboratory wipe soaked with acetone. The paper clip is positioned as spacer on one side between the glass plates, while they are clamped tightly together at the opposite edge. The rubber band is then used to hold the two glass plates together. As a result, a kind of wedge is obtained.
Procedure: The wedge is placed into the dyed water in vertical position.

## Observation:

After a short while, one observes that the water rises on the narrower side. At the end, the surface of water in the wedge takes the shape of a hyperbola.

**Explanation:**

The wedge-shaped space between the glass plates, which form a small angle with each other, can be imagined as filled with a series of vertical capillary tubes whose radius increases with the distance from the edge where the glass plates touch.

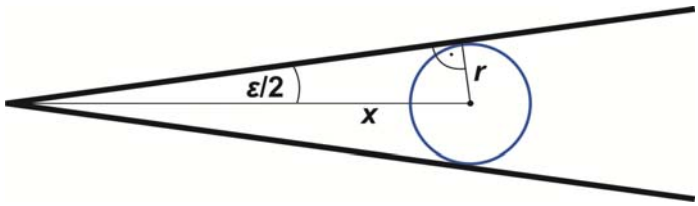


The capillary rise $h$ of a liquid with a surface tension $\sigma$ and a density $\rho$ depends on the radius $r_C$ of the capillary tube:

$$h = \frac{2\sigma}{\rho r_C g}.$$

If $\varepsilon$ is the small angle between the two glass plates, the radius $r$ of an imaginary capillary tube in the distance $x$ from the edge where the glass plates touch is given by

$$r = x \sin(\varepsilon/2).$$




Inserting this expression into the above formula for the capillary rise results in

$$h = \frac{1}{x}\frac{2\sigma}{\rho g \sin(\varepsilon/2)}$$

for the height $h$ of the water in the slit between the plates in dependence of the distance $x$. Since all quantities on the right side except of $x$ are constant, the surface of water in the wedge thus takes the shape of a hyperbola ($h \sim 1/x$) as observed in the experiment.

**Disposal:**

The dyed water can be disposed of by flushing it down the drain. The laboratory wipe with the small amount of acetone is put in a small garbage bag and disposed of with the household waste.